放物型コストカ多項式、えびら多様体、結晶基底とトロピカル組み合わせ論

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はしがき

The reprints presented in this collection constitute a part of the papers contributed to the Project by its members.

In paper [2] I have studied the so-called Saturation Conjecture for parabolic Kostka polynomials, Littlewood-Richardson numbers, and related topics, like Schur-positivity of certain symmetric functions, generalized Fulton's conjecture and so on. One of The basic results of [2] is a proof of Generalized Saturation Conjecture for the so-called rectangular case. The basic tool is a fermionic formulas for certain parabolic Kostka polynomials obtained by the author and N.Reshetikhin several years ago.

A series of papers [1,3,7,9] jointly with T.Maeno, and [11], are concerned to the study classical and quantum Schubert and Grothendieck Calculi from noncommutative algebra and geometry points of view. One of the main results of these papers is a construction for any finite Coxeter a certain noncommutative algebra to together with special sets of mutually commuting elements, in such a way that the former generate subalgebras which are isomorphic to the classical/quantum cohomology ring or K-ring of the corresponding flag varieties (in the case of Weyl groups), or coinvariant algebras. This new approach to classical problems of Schubert Calculus allows not only to find new proofs for known results, but obtain some progress in the Littlewood-Richardson problem in Schubert Calculus, in the construction of finite dimensional Nichols-Woronowicz algebras, noncommutative differential geometry (in the sense of S.Madjid) on Coxeter groups, and so on. I believe that this approach to Schubert and Grothendieck Calculi have to have further investigation.

In papers [4,6] we discover and employ some interesting and unexpected connections between quantum invariants of torus knots, characters of minimal models of Conformal Field Theory and Zagier's theory of quasi-modular forms. Using these ideas, we give among other things, some new generalization of classical identities of Rogers-Ramanujan and Slater types.

In the paper [12] by M.Noumi and Y.Yamada a very interesting approach to the construction of the tropical Robinson-Schensted-Knuth correspondence and to construction of birational representations of affine Weyl groups has been presented. Originally, many of these results were obtained using different methods by A.Berenstaen and A.N.Kirillov as a part of program of tropicalization of the classical combinatorics related with representation theory of symmetric groups. In [8] we gave a brief introduction Tropical Algebraic Geometry. An interesting and deep connections between the latter, Tropical Combinatorics and Discrete Integrable Systems certainly have to be studied further.

In the paper [10] we give some interesting applications of the Sato theory of infinite dimensional grassmannians to the so-called Askey-Wilson polynomials and functions.

In the paper [14] by S. Ariki the representation type for all of the Hecke algebras of classical type has been determined. In a few words, one of the main result of the paper states that the representation type of a one-parameter Hecke algebra is governed by its Poincare polynomial.

In the paper [13] by H.Nakajima some new and interesting results about the so-called Kirillov-Reshetikhin modules for quantum affine Lie algebra of ADE type has been obtained.

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